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THE ROUTINE POST-MORTEM REMOVAL OF LIVER TISSUE FROM RAPIDLY FATAL FEVER CASES FOR THE DISCOVERY OF SILENT YELLOW FEVER FOCI *

BY

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For more than three decades it has been known that yellow fever is transmitted by *Aëdes aegypti*. During this period anti-mosquito measures have been applied and have resulted universally in the disappearance of yellow fever from the mortality records of towns and cities in which such action has been taken. An unexpected result of the early campaigns was the spontaneous apparent disappearance of yellow fever from large tributary areas as well as from the centers worked. This phenomenon was observed so constantly that a satisfactory explanation was hypothecated and on this hypothesis a whole generation of epidemiologists planned the final elimination of yellow fever from the world through the application of anti-aegypti measures in a relatively few, arbitrarily selected, "key-centers" of population lying within the known endemic areas. This key-center program did not require detailed studies of the conditions under which yellow fever occurred outside the large cities, since it was assumed that in tributary areas the disease would spontaneously clear up or burn out in a short time in the absence of reinfection from the large cities.

* The studies and observations on which this paper is based were conducted by the Cooperative Yellow Fever Service maintained by the Brazilian Government and The Rockefeller Foundation, with the active participation of the Bahia Yellow Fever Laboratory of The Rockefeller Foundation.

Certain events of the past few years have indicated that the epidemiology of yellow fever is much more complex than it was previously believed to be and have shown the necessity of a thorough study of the conditions under which yellow fever occurs today in the field. Among such events may be cited:

1. The failure of yellow fever to disappear from Brazil despite prolonged campaigns of key-center control;
2. The reappearance of yellow fever in Colombia in 1929 (1) without any evidence of reimportation from known infected areas;
3. The demonstration of the occurrence of yellow fever in the absence of *Aëdes aegypti,* first in a rural area of Espirito Santo, Brazil, in March, 1932 (2), and later, in May, 1933, in the small isolated village of San Ramón, Bolivia (3).
4. The declaration of a frank epidemic of yellow fever in non-immune troops from the uplands at Santa Cruz, Bolivia, in March, 1932 (4, 5). Santa Cruz, with less than 20,000 population, cannot be considered a key-center of population, and, furthermore, lies thousands of miles from any such key-center and from any other known focus of yellow fever infection.
5. The confirmation by animal protection tests of acquired immunity to yellow fever in individuals belonging to the younger age-groups in areas long believed free from the disease and in districts never known to have been infected (6).

The difficulties encountered in the study of yellow fever in the native populations of endemic areas cannot be properly appreciated by those whose ideas of the clinical and epidemiological manifestations of the disease have been acquired from the literature of yellow fever, which is largely based either on observations of the disease in groups of newly-arrived non-immunes in the large cities of endemic areas, or on its manifestations in epidemics occurring in non-immune populations residing outside the truly endemic areas. Classical clinical cases of yellow fever occurring during epidemics among non-immune troops or immigrants in endemic areas, and in populations living beyond the usual yellow fever zone, are not, generally, difficult to diagnose. The diagnosis of yellow fever, however, becomes rapidly more difficult as the number of classical cases decreases and isolated cases observed in the field in endemic areas can almost never be diagnosed clinically with certainty. Experience in Brazil has shown that the clinical diagnosis of yellow fever is most difficult in those endemic regions where it is most constantly present. As control measures be-

come effective in the larger centers of population, where the movement of non-immunes is most intense, yellow fever apparently disappears from the surrounding area, but in reality often continues silently in the native population for an indefinite period with but few fatalities, which are readily attributed to malaria, influenza, typhoid fever, and other acute infections.

Various authors have called attention to the occurrence of mild cases in endemic regions and the necessity of recognizing these cases. But the recognition of mild cases in the field is, under present conditions, practically impossible. It is possible, however, to discover some of the occasional fatal cases which do occur, through the examination of liver sections, since characteristic lesions are usually found in this organ. The results of an attempt to discover the active endemic foci of yellow fever in Brazil through the routine examination of liver sections, removed post-mortem from febrile cases of less than ten days' duration, between April, 1930 and June, 1933, are herewith reported.

History of the development of the routine liver collection service in Brazil.

The possibility of determining, through the examination of autopsy material from a large number of fatal febrile cases, the location of those silent foci of yellow fever responsible for maintaining the endemicity of the disease in North Brazil * was repeatedly discussed with the public health authorities during 1928 and 1929, but no serious attempt was made at the routine collection of specimens previous to April, 1930.

Following the widespread appearance of cases of yellow fever in Brazil in 1928 and 1929, the disease apparently disappeared from all of North Brazil, and no confirmed cases were recorded for this area from July of 1929 to March of 1930, when an outbreak occurred in Bôm Conselho, Pernambuco, and a suspect case was reported in Belém, Pará. The latter case, although finally declared negative after examination of liver tissue, called attention once more to the possibility of the existence of yellow fever in the Amazon Basin. The city of Belém, at the mouth of the Amazon, as well as the entire Amazon Valley, gives no definite history of yellow fever between 1913 and 1929. In January of 1929 several confirmed cases occurred, followed

* North Brazil, as used in this article, comprises the State of Bahia and all states lying north of Bahia.

by occasional cases, until July of the same year. This outbreak, limited to a total of twelve declared cases, distributed over a period of seven months and occurring in various parts of the city, was limited to adult foreigners, despite the fact, that, historically, at least, all native-born children under seventeen years of age should have been non-immune and susceptible to the disease (7). In connection with the suspect case of March, 1930, it was noted that there had been a very high mortality reported for malaria during the first trimester of the year and the possibility of a masked outbreak of yellow fever was considered. To help clarify this situation, the State authorities of Pará granted permission on April 9th for the Yellow Fever Service to perform partial autopsies on all fatal febrile cases of less than ten days' duration. The first partial routine autopsy was secured on April 21, 1930, and the second on May 10. On May 17 one of us (PJC) accidentally learned of the death of a Brazilian child of four years of age from a febrile attack of six days' duration in Val de Caes, a small town lying three miles from Belém. Since this fell within the class of cases upon which routine autopsies were being performed, a liver section was removed, which resulted in a diagnosis of yellow fever. This was the first indication of the persistence of the disease in the neighborhood of Belém in nine months. Only on June 21 did a single, isolated, clinically recognized case of yellow fever appear in the city.

The routine collection of liver specimens was begun at Natal, Rio Grande do Norte, in cooperation with the Prophylaxia Rural, early in May, 1930, and did much to relieve apprehension regarding the possible existence of yellow fever in the city during a sharp and unusual epidemic of malaria, attributed to the recent introduction of *Anopheles gambiae* (Giles) on the American continent (8).

It is interesting to note that the routine collection of liver specimens for the discovery of endemic areas of yellow fever was independently organized almost simultaneously in North and South Brazil. In March, 1930, the Yellow Fever Service of the State of Rio de Janeiro, alarmed by the appearance of suspicious lay diagnoses in the mortality records of Santo Aleixo (9), gave instructions for the autopsy of all bodies presented for burial at this point. The result was a positive diagnosis of yellow fever on the first case so autopsied on March 29. Previous to this diagnosis yellow fever had not been known in the State of Rio de Janeiro for about six months. The necessity of investigation of other parts of the state was recognized, and in May an organization was developed for securing liver specimens

from sections where it was believed the presence of malaria might mask the presence of yellow fever. For this purpose several local civil registrars were brought together, given demonstrations and instructions as to methods of securing liver specimens, and promised a cash payment for each liver specimen forwarded to the Health Department from fatal fever cases of less than eight days' duration presenting any of the more common symptoms of yellow fever. In order to make the cooperation of these registrars effective, all cemeteries were prohibited from permitting burial of bodies unaccompanied by death certificates approved by the local registrar. Since the registrar himself had a financial interest in securing the desired specimen, this method was very effective. About one hundred specimens were examined in the State of Rio de Janeiro, from the time of the organization of this service in May to the end of August, 1930, and to it must be credited the first demonstration of the possibility of securing liver specimens from interior points with non-medical personnel.

During June, attempts were made to organize routine partial autopsy services in North Brazil, in the States of Sergipe, Alagôas, and Pernambuco. The attempt to organize a practical service for the interior of the latter state led one of us (ERR) to attempt the design of an instrument for the removal of liver tissue without autopsy. This instrument, later christened the "viscerotome" by Dr. Mario Bião, reached a practicable stage of development within a few weeks. It is designed to enable the layman to remove sections from cadavers rapidly, without the necessity of handling the body or tissues, and with minimal mutilation of the body.

Description of the viscerotome. The construction of the viscerotome is shown in figures 1, 2, and 3. The instrument consists of but two parts (fig. 1).

1. A square metal trough having a handle at the proximal end, and one basal and two lateral cutting surfaces at the distal end. The internal surfaces of the side-walls of the trough have longitudinal grooves with a downward curve just proximal to the lateral cutting surfaces;

2. A sliding blade which operates in the grooves of the trough with a cutting surface at its distal extremity.

When the sliding blade is pushed forward, the curved grooves of the trough cause the distal extremity of the blade to bend downward and come into contact with the floor of the trough (fig. 2). In this position the viscerotome becomes a four-sided closed punch with three

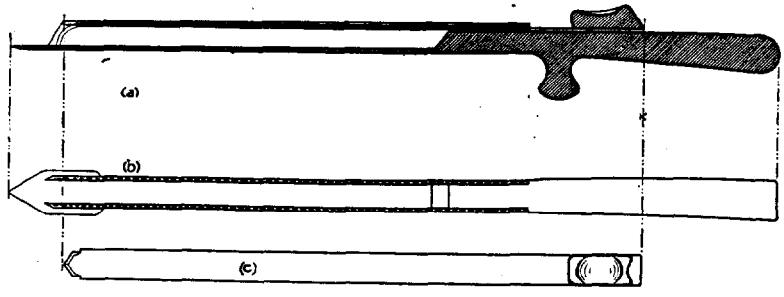


FIG. 1. (*a*) Sectional view of viscerotome with sliding blade in cutting position. (*b*) Plane view of viscerotome with sliding blade withdrawn. (*c*) Sliding blade.

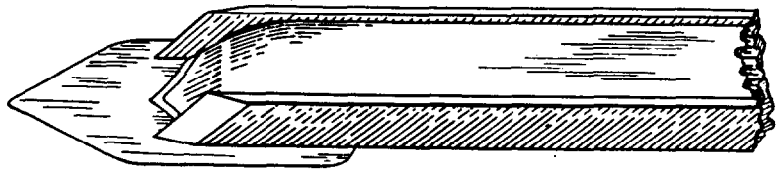


FIG. 2. Distal portion of viscerotome showing position of sliding blade during introduction and withdrawal from the body.

sharp cutting surfaces, which may be forced through the body-wall without removing any tissues. Once the point of the instrument has entered the liver, the sliding blade may be retracted just beyond the curve in the grooves and the instrument thus opened for the reception of liver tissue, with sharp cutting surfaces on the four sides of its lumen (fig. 3). If the open instrument be forced further into the liver and the sliding blade be again pushed forward the liver section is complete.

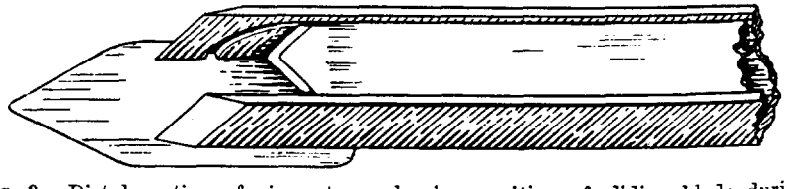


FIG. 3. Distal portion of viscerotome showing position of sliding blade during cutting of liver tissue.

The viscerotome has made possible the routine collection of liver specimens by non-medical personnel, over a wide area, with a minimum of trouble and expense. The removal of sections by the viscerotome does not constitute an autopsy, and is, in fact, hardly more than

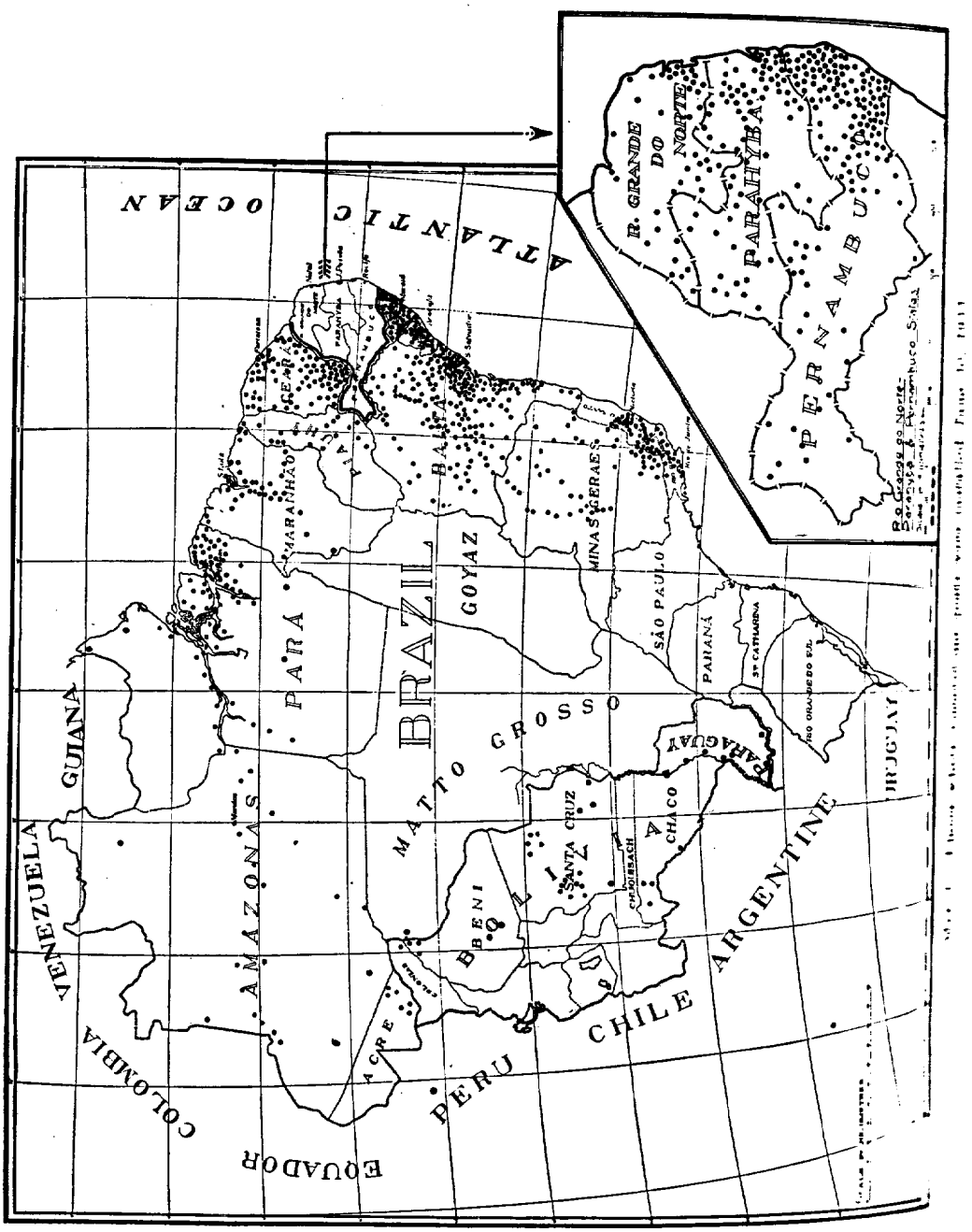
a simple puncture. The opposition of relatives and friends to autopsy is greatly reduced in the case of viscerotomy, since the operation is very rapid and practically no mutilation occurs. A practiced operator often requires no more than thirty seconds for a viscerotomy. The opening made by the instrument is very small, no skin or muscle is removed, and no sutures are required for closing. The operator need not touch the cadaver with his hands, and the corpse may remain in the coffin almost fully clothed.

In February, 1931, viscerotomes were distributed to selected representatives in several towns in the interior of Pernambuco, but, during the following three months, the results obtained were negligible. Since the instruments were not placed with the registrars, the viscerotome agents only rarely learned of cases suitable for puncture. Creditable results began to be secured only in June, after the adoption by the State Health Service of a death certificate calling for information regarding the length of final illness and the adoption of regulations prohibiting the burial of any person whose death certificate had not previously been submitted to the viscerotome agent. These were the same measures that had proved effective in the State of Rio de Janeiro in 1930. However, it was discovered that the routine collection of liver specimens, even with the aid of the viscerotome and the control of death certificates and burials, does not carry on automatically, and on June 5 a full-time physician was designated in Pernambuco to direct this service, select representatives, and maintain contract with them, much as a business organization would with its field agents. Once an organization capable of producing satisfactory results had been developed, the program was rapidly extended to other parts of Brazil, and in 1932 to Bolivia and Paraguay (map 1). In June, 1933, the Medical Service of the Brazilian Army made the examination of liver specimens in fatal febrile cases of short duration a routine procedure.

The early results of the Viscerotome Service in Brazil were so important that general regulations for this service were included in Presidential Decree No. 21434 of May 23rd, 1932. A translation of Articles 52, 53, and 57 of this Decree follows:

"ART. 52. The practice of viscerotomy and routine autopsies is hereby established wherever desired by the (Yellow Fever) Service.

Sec. 1. The (Yellow Fever) Service may delegate authority to local representatives duly instructed in the prac-


ATLANTIC OCEAN
R. GRANDE DO NORTE
PARAHYBA
PERNAMBUCO
BRAZIL
PARA
MARANHÃO
GOYAZ
MINAS GERAES
SÃO PAULO
PARANÁ
MATTO GROSSO
PARAGUAY
CHACO
SANTA CRUZ
BENI
ACRE
AMAZONAS
VENEZUELA
GUIANA
COLOMBIA
ECUADOR
PERU
CHILE
ARGENTINE
URUGUAY

tice of 'viscerotomy,' to whom all deaths occurring after less than ten days' illness must be immediately notified.

Sec. 2. In those places where the (Yellow Fever) Service has a representative for the practice of 'viscerotomy,' permits for burial in cemeteries, chapels, churches, or private burial grounds, may be issued by the civil registrar only on the presentation of death certificates duly visaed by said representative.

"ART. 53. Any opposition to the above measures shall be punished by a fine of from 50$000 to 1:000$000 and by the intervention of the police authority which shall cause the immediate execution of the autopsy or viscerotomy desired.

"ART. 57. By 'viscerotomy' is understood the puncture of cadavers for the extraction of a section of any organ for diagnostic purposes."

Results of the routine liver collection program.

Between August, 1928, when the Bahia Yellow Fever Laboratory began the examination of tissues from suspect cases of yellow fever, and May, 1930, when the first specimen from a routine autopsy arrived, a total of twenty-seven examinations, with nineteen positive diagnoses, was made. From May, 1930, to June, 1933, 28,468 tissues were examined, with seventy-five positive diagnoses. The growth * and results of the liver collection service are shown in table 1.

Of the seventy-five diagnoses of yellow fever made at the Bahia laboratory after the organization of the first routine liver collection service, only twenty-one were made on tissues from cases clinically suspected of being yellow fever. The remaining fifty-four cases came from forty-three different places, not known to be infected at the time the pathological diagnoses were made. These were distributed by states, as follows (map 2):

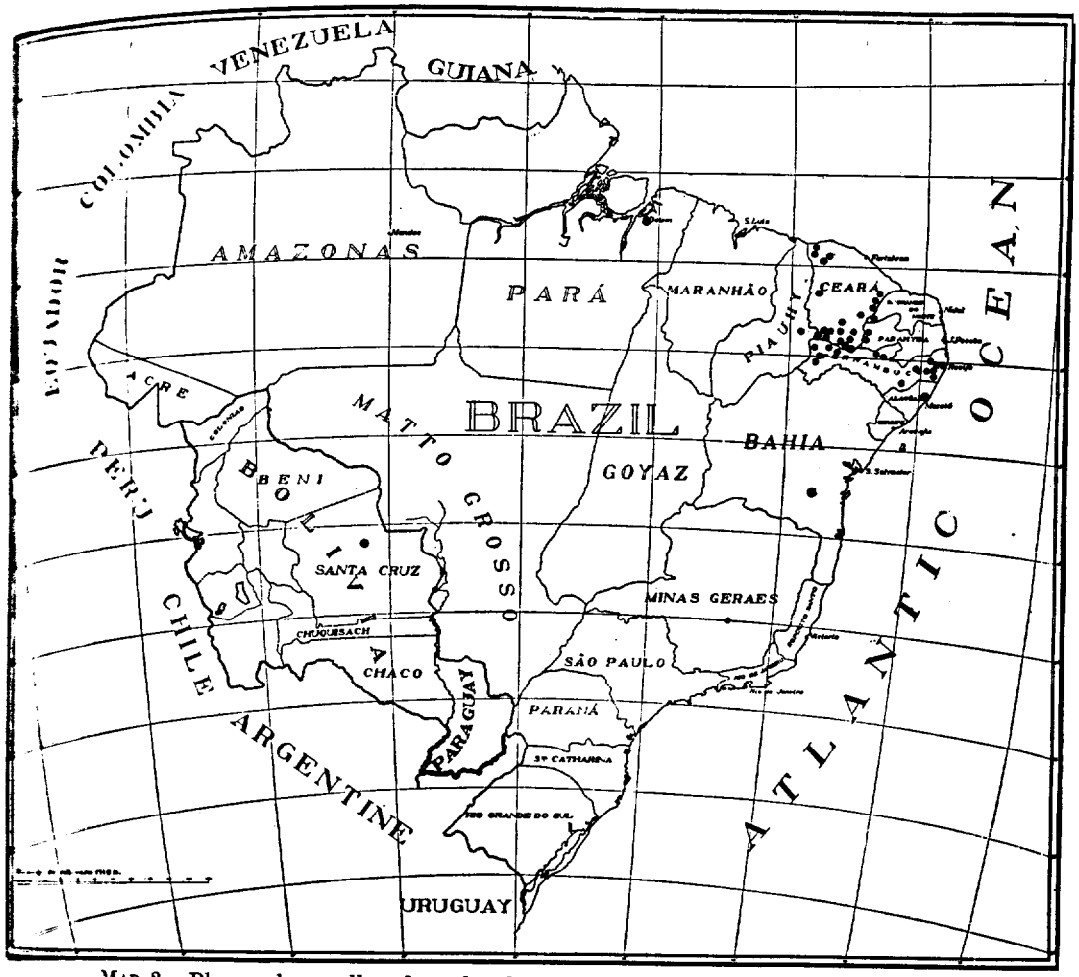
* Previous to March, 1933, liver specimens were routinely obtained from cadavers of persons dying of acute illness of not less than ten days' duration. Cases of death from accident, homicide, sudden death, and puerperal conditions, etc., were, naturally, excluded, as were also deaths of infants of less than one month of age. From March to June, 1933, no punctures were made in infants of less than six months of age.

TABLE 1.

*Liver tissues examined at Bahia Yellow Fever Laboratory August, 1928, to June 30, 1933.**

Source	Before routine collection		After routine collection											
	Aug. 1928 Apr. 1930 21 months		Total May 1930 June 1933 38 months		May 1930 Dec. 1930 8 months		Jan. 1931 Dec. 1931 12 months		Jan. 1932 June 1932 6 months		July 1932 Dec. 1932 6 months		Jan. 1933 June 1933 6 months	
	Examined	Positive	Examined	Positive	Examined	Positive	Examined	Positive	Examined	Positive	Examined	Positive	Examined	Positive
Brazil														
Amazonas	—	—	568	0	—	—	—	—	16	0	322	0	230	0
Pará	4	3	1824	2	35	2	300	0	395	0	362	0	732	0
Maranhão	—	—	247	0	2	0	2	0	54	0	63	0	126	0
Piauhy	—	—	175	1	—	—	3	0	16	0	20	0	136	1
Matto Grosso	—	—	7	0	—	—	—	—	—	—	1	0	6	0
Ceará	—	—	7496	21	—	—	201	5	501	1	3102	10	3692	5
R. G. Norte	2	0	2233	1	19	0	86	0	483	0	609	1	1036	0
Parahyba	1	0	3587	4	—	—	63	0	474	1	1249	3	1801	0
Pernambuco	12	10	6363	24	4	2	752	5	1120	2	2059	14	2428	1
Alagôas	1	0	1624	2	1	0	87	2	346	0	606	0	584	0
Sergipe	2	2	363	0	—	—	1	0	51	0	82	0	229	0
Bahia	5	4	2501	5	2	0	5	0	127	4	844	0	1523	1
Minas Geraes	—	—	499	0	—	—	—	—	134	0	166	0	199	0
Esp. Santo	—	—	296	3	—	—	—	—	108	3	110	0	78	0
R. de Janeiro	—	—	504	0	—	—	—	—	105	0	169	0	230	0
Dist. Federal	—	—	2	0	—	—	—	—	—	—	1	0	1	0
Argentina	—	—	9	0	—	—	—	—	—	—	8	0	1	0
Bolivia	—	—	110	12	—	—	—	—	—	—	29	11	81	1
Paraguay	—	—	60	0	—	—	—	—	—	—	1	0	59	0
Totals	27	19	28468	75	63	4	1500	12	3930	11	9803	39	13172	9

* The examination of tissues was carried out by Dr. Nelson C. Davis, Director of the Bahia Yellow Fever Laboratory, except for some months in 1931 when the examination was made by Drs. M. Frobisher, Jr., and H. W. Kumm. Cases reported positive were in most instances submitted to Dr. Amadeu Fialho, of the Pathological Laboratory of the National Department of Health of Brazil, and to Dr. [illegible] Kloetz, of the Banting Institute, University of Toronto, Canada.



MAP 2. Places where yellow fever has been diagnosed through routine examination of liver tissue, May, 1930, to June, 1933.

	Places	Cases
Brazil		
Pará	1	1
Piauhy	1	1
Ceará	20	22
Rio Grande do Norte	1	1
Parahyba	2	4
Pernambuco	15	22
Alagôas	1	1
Bahia	1	1
Bolivia	1	1
Total	43	54

A scarcely less valuable result of the viscerotome service was the accumulation of thousands of negative specimens from cities and towns engaging in anti-mosquito campaigns, indicating that the control measures employed were adequate to prevent local outbreaks of the disease.

The tissues received from viscerotome representatives included a small proportion of specimens unsuitable for examination. Since tissues are often secured only at the hour of burial, some show post-mortem changes sufficiently advanced to make a diagnosis impossible. Such advanced changes have been found in only 796, or 2.8 per cent of the total number of specimens received. Occasionally a puncture is unsuccessful and tissue other than liver obtained, and occasionally containers are broken in transit to the laboratory. These two sources of loss accounted for a total of 369 specimens, or 1.3 per cent. Unscrupulous representatives, whose compensation is based on the number of specimens forwarded, have occasionally sent multiple blocks of tissue from the same case under different names, and even blocks of tissue from animal livers. Fortunately, liver specimens usually show individual characteristics, and repeated fraud generally leads to detection in the laboratory. Probable duplication of specimens has been recorded from thirty-six places involving 118, or 0.4 per cent of specimens received. Dishonest representatives have also collected tissues from non-indicated febrile cases and from cases of more than ten days' illness. However, comparative analysis of statistics from different places often reveals the localities where non-indicated cases are being punctured. On the other hand, the general public sometimes learns that only cases of less than ten days' illness are being punctured, with the result that more than ten days' duration is attributed to all fatal illnesses. Here, again, comparative statistics are valuable. In extreme cases, puncture of all cadavers from an area has been temporarily employed to overcome this tendency to falsify the duration of illness.

Discussion.

Events of the past few years have clearly shown that the absence of epidemics and of declared cases of yellow fever from an area does not indicate the absence of the disease from that area. Protection tests in Brazil (6) have shown a high percentage of immunity to yellow fever in certain places where no history of the disease is obtainable, and the suggestion has been made that yellow fever may occur in certain epidemics in a mild non-fatal form. Although it has

been shown that yellow fever may carry a very low mortality in the native population of endemic areas (10, 11), the routine examination of liver tissue indicates that silent endemic foci are not silent because of an absence of fatal infections but because of the failure to recognize them. Studies to date indicate, at least for Brazil, that large series of infections without some fatalities do not often occur. On the other hand, it seems that the virus of yellow fever can be maintained for relatively long periods of time with the production of comparatively few fatal infections.

The problem of the distribution of yellow fever may be attacked directly or retrospectively. Retrospective methods of attack include: (1) the investigation of mortality statistics and history taking; (2) complement-fixation test, and (3) the protection test. Direct methods of attack include: (*a*) the maintenance of lay investigators in suspect areas, with instructions to investigate all febrile cases, and report daily on temperature, pulse, and albuminuria of cases seen; (*b*) inoculation into susceptible animals of mosquitoes captured within houses of suspect areas; (*c*) the exposure of cages of susceptible animals in suspect areas, with autopsy in case of illness and death, or protection test for acquired immunity after a period of exposure; (*d*) the inoculation into susceptible animals of blood from febrile cases in suspect areas; (*e*) the autopsy of suspect cases; and (*f*) the routine partial autopsy or viscerotomy in fatal febrile cases of short duration.*

The methods which have been found most valuable and most practicable on a large scale, viz., (1) the mouse-protection test applied to samples of blood from selected groups of the population of the areas investigated, and (2) the routine post-mortem removal of liver tissue, are both independent of a notification of suspect cases of yellow fever. This is highly important, since suspect cases are very rare in true endemic areas not having an influx of non-immune immigrants. The information secured by each of these methods is complementary to, but basically different from that secured by the other. The first gives the cumulative picture of past exposure to the virus of yellow fever; the second a current picture of mortality from yellow fever and an indication of the present distribution of the yellow fever virus.† The

* Viscerotomy is not intended to supplant the complete autopsy recommended for suspect cases which merit the fullest possible investigation.

† A most striking example of the value of combining the results of protection tests and routine liver examinations in field studies is afforded by work done at San Ramón, Bolivia, by Drs. René Valda and Angel Claros under the

data from the protection test serve to outline the distribution of immunity to yellow fever corresponding to the area of past diffusion of the virus and indicate the area where the organization of the viscerotome service may be most profitable. However, the relationship of past diffusion of the virus to the permanent endemic foci of yellow fever and to the future distribution of the virus is not simple. Numerous articles have been published on the value of the protection test in delimiting endemic areas of yellow fever and the writers of this article have been among the most enthusiastic in pushing studies on the distribution of immunity to yellow fever, which have resulted in obtaining invaluable information not otherwise available. However, as data on immunity distribution have accumulated, it has become increasingly evident that their application to the problem of yellow fever control is difficult. The distribution of yellow fever in endemic areas is constantly changing, due in part to changes in living conditions, especially in facilities of transportation, and in part to the building up of a high percentage of immunes in infected places and the gradual growth of new crops of susceptibles in places temporarily free of the disease. No criteria other than the uncertain analysis of the distribution of immunity by age-groups exist for the interpretation of immunity statistics in terms of the history of yellow fever in the places studied. Dr. F. F. Russell "has stated the difficulty clearly in informing the Yellow Fever Commission that 'a recent epidemic in a highly susceptible community, or two or three epidemics at rather long intervals, might give the same percentage of

direction of Dr. A. M. Walcott. Dr. Valda visited San Ramón, an isolated village of one hundred and twenty-five people, in September, 1932, and was told of suspect cases of yellow fever occurring as early as June of the same year. Although canvass of the community failed to reveal larval foci or adults of *Aëdes aegypti*, two of the three blood specimens collected at this time were shown to have protective properties for mice against the virus of yellow fever. In January, 1933, reports of further suspect cases were received and investigation by Dr. Claros in February indicated that two-thirds of the population of this small village had, during the previous months, despite the absence of *Aëdes aegypti*, suffered from a disease greatly resembling yellow fever. Six of eight blood specimens taken in February proved to possess protective qualities, again indicating the probability of yellow fever in the place. A viscerotome representative was selected in February, but the first case suitable for puncture did not occur until early in May. Examination of this first liver specimen by Dr. Davis resulted in a diagnosis of yellow fever. Confirmation of the continued presence of yellow fever in the absence of *Aëdes aegypti* in a small village eleven months after the occurrence of the first suspicious cases is a very important epidemiological finding, made possible only by following up clinical findings and protection test results with routine examination of pathological specimens.

immunes as would be caused if the infection were constantly present in a community large enough to permit the disease to persist continuously.' Epidemiologically and for the purposes of control and prevention it is important to know whether localities are in the former or in the latter category." (12.)

In this connection it may be noted that epidemics spread by unusual troop movements in 1926, the outbreak of yellow fever in Rio de Janeiro in 1928–1929, and the unusual flux of populations temporarily driven from their homes in Northeastern Brazil by the drought of 1931–32, have all resulted in building up immunity to yellow fever demonstrable by the protection test in areas which may possibly not be of great importance in maintaining permanent endemicity at the present time.

The information secured from the examination of routine post-mortem liver tissues, on the other hand, is definite, easily interpreted, and permits an investigation of the conditions under which yellow fever occurs in endemic areas. Immediate action can be taken to prevent the further dissemination of the virus from the known infected point. Fatal cases of yellow fever are far more potent arguments for active cooperation of all authorities concerned than are high percentages of positive protection tests. Anti-mosquito measures have been extended and intensified as a result of diagnoses based on routine liver tissues in silent endemic areas where such control measures could have been justified in no other way. The routine liver collection service has demonstrated that such silent endemic foci are "silent" not because fatal cases of yellow fever do not occur, but because they occur in such small numbers that only pathological diagnoses are convincing.

The negative information accumulated by the liver-collection service is highly important, indicating the probable absence of the virus from large suspect areas apparently differing in no other respect from areas shown to harbor the virus. Negative viscerotome results from all the larger centers of population during the past few years have been particularly comforting to control workers in Brazil.

The organization of the routine liver-collection service is based on the following assumptions:

1. That the existence of yellow fever in a community over a period of months will result in some fatal infections;
2. That the yellow fever LIVER usually shows characteristic lesions; and
3. That fatal yellow fever kills rapidly, its victims rarely surviving more than ten days.

The advantage of the viscerotome service over other methods for the direct discovery of yellow fever is that it does not depend on the finding of suspect cases, nor on the ferreting out of febrile illnesses. Illness is easily overlooked, but burial of the dead occurs only after the observance of certain civil and religious formalities which call attention to the fact that a death has occurred. Legal regulations controlling burials bring indicated cases automatically to the notice of the viscerotome representative. Death diagnoses itself, and only a little judicious inquiry is necessary to ascertain if the fatal illness has been of less than ten days' duration.

The introduction of the viscerotome service is expected to aid greatly in clearing up other public health problems and in accustoming the medical profession and the public to post-mortem examinations. The viscerotome service has already resulted in punishing one practising physician for failure to notify a case which he himself believed to be yellow fever. Two interesting cases have occurred in which poisoning and yellow fever were confounded. In the first of these cases the police strongly suspected criminal poisoning, but the laboratory report showed that death had been due to yellow fever. In the second case, in which both yellow fever and criminal poisoning were suspected, the laboratory examination showed that death had not been due to yellow fever. The possibility of mass pathological work on a large scale has been demonstrated and much valuable information regarding the distribution of other diseases producing characteristic liver lesions, such as malaria and schistosomiasis, has been obtained.

Summary and conclusions.

1. The organization of a service for the routine post-mortem collection of liver tissue from rapidly fatal febrile cases resulted, between May, 1930, and June, 1933, in the examination of tissues from over twenty-eight thousand livers, and a pathological diagnosis of yellow fever in fifty-four cases, from forty-three places in which yellow fever was not known to be present.

2. A special instrument designed for the rapid removal of liver tissue by laymen without autopsy, to which the name "viscerotome" has been given, is described.

3. The routine liver collection program has resulted in:

(*a*) The demonstration of typical fatal cases of yellow fever in otherwise silent endemic foci;

(*b*) The accumulation of extensive data indicating, so far as negative evidence can indicate, the absence of the yellow fever virus from key-centers of population and from hundreds of towns and villages in which anti-mosquito measures are being applied;

(*c*) The confirmation of yellow fever without *Aëdes aegypti* in a small village, eleven months after the occurrence of the first suspect case.

(*d*) The accumulation of valuable data regarding the distribution of diseases other than yellow fever producing characteristic liver lesions.

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